(i) first signals from a first signal source, said first signals being related at least in part to said stimulation current; and

(ii) second signals from a second signal source, said second signals being useful in the determination of cardiac output; [and]

said first interface further comprising a multiplexer adapted to selectively multiplex individual ones of said second signals; and

a second interface adapted to at least provide output data to a monitoring device.

32. A method of determining the cardiac output of a living subject, comprising:

generating an electrical current;

applying said electrical current to at least a portion of said living subject;

measuring an impedance waveform generated by said electrical current passing through said living subject;

obtaining a cardiographic waveform from said subject during at least a portion of said act of measuring;

converting at least a portion of said impedance and cardiographic waveforms to the digital domain;

removing at least one of respiration and motion artifact from at least one of said impedance and cardiographic waveforms;

determining stroke volume from the measured voltage; and

determining cardiac output based at least in part on said stroke volume.

70. The yoke apparatus of Claim 61, [wherein said] further comprising an outer housing [is] of molded construction, [and] wherein said second interface comprises a multi-pin electrical connector.

Also, please add new Claims 87-101 as follows:

87. Cardiac output measuring apparatus, comprising:

a stimulation source adapted to produce a stimulation current;

a first interface adapted to receive;

(i) first signals from a first signal source, said first signals being related at least in part to said stimulation current; and

(ii) second signals from a plurality of second signal sources, said second signals being useful in the determination of cardiac output;

said first interface further adapted to select at least one of said plurality of second signal sources; and

a second interface adapted to at least provide output data to a monitoring device.

88. Cardiac output measuring apparatus, comprising:

a stimulation source adapted to produce a stimulation current;

a first interface adapted to receive;

(i) first signals from a first signal source, said first signals being related at least in part to said stimulation current; and

(ii) second signals from a second signal source, said second signals being useful in the determination of cardiac output; and

a second interface adapted to at least provide output data to a monitoring device;

wherein said apparatus is further adapted to identify one of respiration artifact or motion artifact within one of said first or second signals.

89. Cardiac output measuring apparatus, comprising:

a stimulation source adapted to produce a stimulation current;

a first interface adapted to receive;

(i) first signals from a first signal source, said first signals being related at least in part to said stimulation current; and

(ii) second signals from a second signal source, said second signals being useful in the determination of cardiac output;

a second interface adapted to at least provide output data to a monitoring device; and

at least one computer program having at least first and second software modules.

90. The apparatus of Claim 89, wherein:

said first module comprises an initialization module; and

said second module comprises an operating module.

91. The apparatus of Claim 90, wherein said computer program further comprises a third module adapted for processing of at least one of said first or second signals.

92. The apparatus of Claim 90, wherein any of said first and second modules may be independently downloaded to said apparatus.

93. The apparatus of Claim 90, wherein said initialization module comprises an operating system adapted for at least input/output and inter-process communication.

94. Cardiac output measuring apparatus, comprising:

a stimulation source adapted to produce a stimulation current;

a first interface adapted to receive;

(i) first signals from a first signal source, said first signals being related at least in part to said stimulation current; and

(ii) second signals from a second signal source, said second signals being useful in the determination of cardiac output from a living subject;

a second interface adapted to at least provide output data to a monitoring device; and

a computer program adapted to identify at least one fiducial point within at least said first signals using only additions and multiplications of real numbers.

95. Impedance cardiography apparatus, comprising:

a first electrical assembly adapted to receive a plurality of impedance and ECG signals from a living subject via a first electrical interface;

a second electrical assembly adapted to process at least a portion of said plurality of impedance and ECG signals using a first digital processor; and

a computer program running on at least in part on a second digital processor in communication with said first processor and adapted to provide at least input/output functions for said apparatus.

96. The apparatus of Claim 95, wherein said first assembly further comprises an ECG signal multiplexer.

97. ICG monitoring apparatus, comprising:

a monitor; and

a transceiver operatively coupled to said monitor;

wherein said transceiver is adapted to at least receive a plurality of data relating to the cardiac function of a living subject substantially simultaneously from each of a plurality of ICG modules placed in data communication with said transceiver.

98. The apparatus of Claim 97, wherein said transceiver comprises a wireless radio frequency (RF) transceiver), and said data comprises at least one of cardiac output or stroke volume data generated by respective ones of said ICG modules.

99. ICG module apparatus, comprising:

a first interface adapted to receive impedance and ECG signals from a living subject;

at least one filtration element adapted to filter at least portions of at least one of said impedance and ICG signals to create filtered signals;

at least one ADC adapted to convert at least a portion of said filtered signals to the digital domain;

a first processor having a computer program running thereon and adapted to at least control input and output functions of said module;

a second processor in data communication with said at least one ADC and having algorithms running thereon adapted to process said digital domain data to produce an output; and

a second interface operatively coupled to said second processor and adapted to provide said output to an external device.

100. The apparatus of Claim 99, further comprising at least one DAC in data communication with said second processor and adapted to convert said output to an analog form before delivery to said second interface.

101. A substantially mobile ICG module, comprising:

a housing;

a first interface adapted for simultaneous signal coupling to a plurality of conductive leads disposed on a living subject;

patient interface circuitry disposed within said housing and operatively coupled to, and adapted at least receive impedance and ECG signals from said subject via, said first interface;

a second interface adapted for at least transmitting signals to an external monitoring device; and

Replacement Claim Sheets

1. Cardiac output measuring apparatus, comprising:

a stimulation source adapted to produce a stimulation current;

a first interface adapted to receive;

(i) first signals from a first signal source, said first signals being related at least in part to said stimulation current; and

(ii) second signals from a second signal source, said second signals being useful in the determination of cardiac output;

said first interface further comprising a multiplexer adapted to selectively multiplex individual ones of said second signals; and

a second interface adapted to at least provide output data to a monitoring device.

2. The apparatus of Claim 1, further comprising data processing apparatus, said processing apparatus being adapted to process at least a portion of said first and second signals to generate said output data.

3. The apparatus of Claim 2, wherein said data processing apparatus comprises:

at least one analog-to-digital converter adapted to convert at least said first signals from the analog domain to the digital domain;

a digital processor, operatively coupled to said at least one converter, adapted to process said digital domain signals.

4. The apparatus of Claim 3, wherein said digital processor comprises a digital signal processor (DSP) with computer program running thereon.

5. The apparatus of Claim 4, wherein said DSP comprises a pipelined processor core with arithmetic logic unit (ALU) which is optimized for at least one arithmetic operation.

6. The apparatus of Claim 4, wherein said computer program comprises a program adapted to identify at least one fiducial point within at least said first signals using a wavelet transform.

7. The apparatus of Claim 6, wherein said first signals comprise an impedance waveform, said second signals comprise ECG signals, and said computer program is adapted to identify at least one fiducial point within each of said impedance waveform and said ECG signals.

8. The apparatus of Claim 1, wherein said second interface further comprises a network interface device adapted to facilitate transmission of said output data to said monitoring device over a data network.

9. The apparatus of Claim 1, wherein said second interface comprises a wireless interface adapted to transmit said output data to said monitoring device over a wireless data link.

10. The apparatus of Claim 9, wherein said second interface comprises a radio-frequency (RF) data link.

11. The apparatus of Claim 9, wherein said second interface comprises an infra-red data link.

12. The apparatus of Claim 9, wherein said monitoring device comprises a personal electronic device (PED) adapted to store at least a portion of said output data therein.

13. The apparatus of Claim 3, further comprising a microprocessor, said microprocessor being configured to control at least a portion of the operation of said cardiac output measuring apparatus and said third interface.

14. The apparatus of Claim 13, wherein said microprocessor includes a computer program adapted to generate said output data according to at least one data communication protocol.

15. The apparatus of Claim 1, wherein said second source comprises a plurality of sources of ECG signals, and said second interface comprises apparatus adapted for selecting between said plurality of ECG signals based on at least one parameter.

16. [Cancelled]

17. The apparatus of Claim 3, further comprising signal filtering apparatus adapted to filter at least a portion of said first and second signals before processing by said processing apparatus.

18. The apparatus of Claim 17, further comprising demodulator apparatus adapted to demodulate said filtered first signals prior to conversion thereof to the digital domain.

19. The apparatus of Claim 3, further comprising apparatus adapted to measure the difference in at least two of said first signals, said difference being compared to a first predetermined value to evaluate the electrical continuity of at least one of the electrical terminals associated with said first signal source.

20. The apparatus of Claim 19, wherein said apparatus adapted to measure the difference comprises a computer program running on said digital processor.

21. Cardiac output measuring apparatus, comprising:

a stimulation source adapted to produce a substantially constant stimulation current;

a first interface adapted to receive first signals from a living subject, said first signals being related at least in part to the impedance of at least a portion of the thoracic cavity of said living subject, said impedance being related at least in part to said stimulation current;

a second interface adapted to receive electrocardiographic (ECG) signals from a signal source, said ECG signals being useful in the determination of cardiac output;

at least one analog-to-digital conversion apparatus adapted to convert said first signals and said ECG signals from the analog to the digital domain;

a first digital processor operatively coupled to said at least one conversion apparatus and having a computer program running thereon, said digital processor being adapted to process at least a portion of said first signals and said ECG signals to develop an estimate of the cardiac output (CO) of said living subject;

a second digital processor adapted to control at least a portion of the operation of said cardiac output measurement apparatus; and

a third interface, operatively coupled to said second digital processor, and adapted to output at least data relating to said estimate of CO to a monitoring device.

22.-31. [Cancelled]

32. A method of determining the cardiac output of a living subject, comprising:

generating an electrical current;

applying said electrical current to at least a portion of said living subject;

measuring an impedance waveform generated by said electrical current passing through said living subject;

obtaining a cardiographic waveform from said subject during at least a portion of said act of measuring;

converting at least a portion of said impedance and cardiographic waveforms to the digital domain;

removing at least one of respiration and motion artifact from at least one of said impedance and cardiographic waveforms;

determining stroke volume from the measured voltage; and

determining cardiac output based at least in part on said stroke volume.

33. The method of Claim 32, wherein the act of determining stroke volume comprises determining ventricular ejection time (VET) and the derivative of impedance, and calculating stroke volume based at least in part thereon.

34. The method of Claim 33, wherein the act of determining cardiac output comprises multiplying stroke volume and cardiac rate.

35. The method of Claim 32, wherein said act of determining stroke volume comprises detecting at least one fiducial point within said impedance waveform using a wavelet transform.

36. The method of Claim 32, wherein said act of obtaining comprises selecting one from a plurality of electrocardiographic (ECG) waveform inputs.

37.-39. [Cancelled]

40. The method of Claim 36, wherein said act of selecting comprises evaluating the signal quality of each waveform based on at least R-wave signal amplitude.

41. The method of Claim 40, wherein said R-wave signal amplitude is determined by:

identifying a first R point value;

subtracting the previous local minimum point value.

42. The method of Claim 41, further comprising:

summing the amplitudes of those R points found in a predetermined time window which includes said first R point value; and

averaging said summed amplitudes to determine a mean R wave signal amplitude.

43.-45. [Cancelled]

46. The method of Claim 36, further comprising determining cardiac rate at least in part from said one selected ECG waveform.

47. The method of Claim 32, further comprising outputting said stroke volume and/or said cardiac output determinations to a monitoring device according to a communications protocol.

48. The method of Claim 32, further comprising outputting said stroke volume and/or said cardiac output determinations via a network interface to a remote monitoring device.

49.-59. [Cancelled]

60. Yoke apparatus adapted to measure cardiac output in a living subject, comprising:

a stimulation source adapted to produce a stimulation current;

a first interface adapted to receive;

(i) first signals from at least one electrodes, said first signals being related to the thoracic impedance of said subject resulting from the application of said stimulation current thereto; and

(ii) second signals from at least one electrode, said second signals being related to the ECG of said subject; and

a second interface adapted to at least provide output data to a monitoring device;

wherein said yoke apparatus is adapted to be physically separable from said monitoring device.

61. The yoke apparatus of Claim 60, further comprising:

at least one analog-to-digital converter, said at least one converter adapted to convert said first and second signals to the digital domain for processing; and

at least one digital processor in data communication with said at least one converter, said at least one processor having at least one computer program running thereon, said at least one computer program being adapted to determine at least ventricular ejection time (VET) from said first and second signals.

62. The yoke apparatus of Claim 61, wherein said at least one computer program is further adapted to detect a plurality of fiducial points with at least said first signals.

63. The yoke apparatus of Claim 62, wherein said detection of said fiducial points is accomplished using discrete wavelet transforms.

64. The yoke apparatus of Claim 60, wherein said second interface comprises a wireless interface adapted to transfer a plurality of data bytes between said yoke and said monitoring device.

65. The yoke apparatus of Claim 61, wherein said wireless interface comprises a Wireless Medical Telemetry Service compliant radio frequency (RF) interface.

66. The yoke apparatus of Claim 60, wherein said second interface comprises a LAN network card adapted to transfer data between said yoke and at least one remote network node.

67. The yoke apparatus of Claim 60, wherein said second interface is adapted to transmit said output data as a plurality of data packets.

68. The yoke apparatus of Claim 60, wherein said second interface further comprises at least one power terminal adapted to receive electrical power from said monitoring device.

69. [Cancelled]

70. The yoke apparatus of Claim 61, further comprising an outer housing of molded construction, wherein said second interface comprises a multi-pin electrical connector.

71.-73. [Cancelled]

74. The yoke apparatus of Claim 60, further comprising a microprocessor and data storage device, said microprocessor, data storage device, and said at least one digital processor being in data communication, said microprocessor at least controlling the transfer of data between said yoke apparatus and said monitoring device via said second interface.

75. The yoke apparatus of Claim 60, wherein said first interface comprises a wireless data interface.

76. The yoke apparatus of Claim 61, wherein said first interface comprises a wireless data interface.

77. The yoke apparatus of Claim 60, further comprising a third interface, said third interface being adapted to receive data from a processing device, said processing device being adapted to determine at least one physical parameter of said subject .

78. The yoke apparatus of Claim 60, further comprising a third interface, said third interface being adapted to transfer cardiac data to a processing device, said processing device being adapted to determine at least one physical parameter.

79. The yoke apparatus of Claim 76, wherein said cardiac data comprises cardiac output (CO) data.

80. – 86. [Cancelled]

87. Cardiac output measuring apparatus, comprising:

a stimulation source adapted to produce a stimulation current;

a first interface adapted to receive;

(i) first signals from a first signal source, said first signals being related at least in part to said stimulation current; and

(ii) second signals from a plurality of second signal sources, said second signals being useful in the determination of cardiac output;

said first interface further adapted to select at least one of said plurality of second signal sources; and

a second interface adapted to at least provide output data to a monitoring device.

88. Cardiac output measuring apparatus, comprising:

a stimulation source adapted to produce a stimulation current;

a first interface adapted to receive;

(i) first signals from a first signal source, said first signals being related at least in part to said stimulation current; and

(ii) second signals from a second signal source, said second signals being useful in the determination of cardiac output; and

a second interface adapted to at least provide output data to a monitoring device;

wherein said apparatus is further adapted to identify one of respiration artifact or motion artifact within one of said first or second signals.

89. Cardiac output measuring apparatus, comprising:

a stimulation source adapted to produce a stimulation current;

a first interface adapted to receive;

(i) first signals from a first signal source, said first signals being related at least in part to said stimulation current; and

(ii) second signals from a second signal source, said second signals being useful in the determination of cardiac output;

a second interface adapted to at least provide output data to a monitoring device; and

at least one computer program having at least first and second software modules.

90. The apparatus of Claim 89, wherein:

said first module comprises an initialization module; and

said second module comprises an operating module.

91. The apparatus of Claim 90, wherein said computer program further comprises a third module adapted for processing of at least one of said first or second signals.

92. The apparatus of Claim 90, wherein any of said first and second modules may be independently downloaded to said apparatus.

93. The apparatus of Claim 90, wherein said initialization module comprises an operating system adapted for at least input/output and inter-process communication.

94. Cardiac output measuring apparatus, comprising:

a stimulation source adapted to produce a stimulation current;

a first interface adapted to receive;

(i) first signals from a first signal source, said first signals being related at least in part to said stimulation current; and

(ii) second signals from a second signal source, said second signals being useful in the determination of cardiac output from a living subject;

a second interface adapted to at least provide output data to a monitoring device; and

a computer program adapted to identify at least one fiducial point within at least said first signals using only additions and multiplications of real numbers.

95. Impedance cardiography apparatus, comprising:

a first electrical assembly adapted to receive a plurality of impedance and ECG signals from a living subject via a first electrical interface;

a second electrical assembly adapted to process at least a portion of said plurality of impedance and ECG signals using a first digital processor; and

a computer program running on at least in part on a second digital processor in communication with said first processor and adapted to provide at least input/output functions for said apparatus.

96. The apparatus of Claim 95, wherein said first assembly further comprises an ECG signal multiplexer.

97. ICG monitoring apparatus, comprising:

a monitor; and

a transceiver operatively coupled to said monitor;

wherein said transceiver is adapted to at least receive a plurality of data relating to the cardiac function of a living subject substantially simultaneously from each of a plurality of ICG modules placed in data communication with said transceiver.

98. The apparatus of Claim 97, wherein said transceiver comprises a wireless radio frequency (RF) transceiver), and said data comprises at least one of cardiac output or stroke volume data generated by respective ones of said ICG modules.

99. ICG module apparatus, comprising:

a first interface adapted to receive impedance and ECG signals from a living subject;

at least one filtration element adapted to filter at least portions of at least one of said impedance and ICG signals to create filtered signals;

at least one ADC adapted to convert at least a portion of said filtered signals to the digital domain;

a first processor having a computer program running thereon and adapted to at least control input and output functions of said module;

a second processor in data communication with said at least one ADC and having algorithms running thereon adapted to process said digital domain data to produce an output; and

a second interface operatively coupled to said second processor and adapted to provide said output to an external device.

100. The apparatus of Claim 99, further comprising at least one DAC in data communication with said second processor and adapted to convert said output to an analog form before delivery to said second interface.

101. A substantially mobile ICG module, comprising:

a housing;

a first interface adapted for simultaneous signal coupling to a plurality of conductive leads disposed on a living subject;

patient interface circuitry disposed within said housing and operatively coupled to, and adapted at least receive impedance and ECG signals from said subject via, said first interface;

a second interface adapted for at least transmitting signals to an external monitoring device; and

processing circuitry disposed within said housing and operatively coupled to said patient interface circuitry and said second interface, said processing circuitry adapted to process said impedance and ECG signals in order to generate an output signal related at least in part to the cardiac function of said subject.